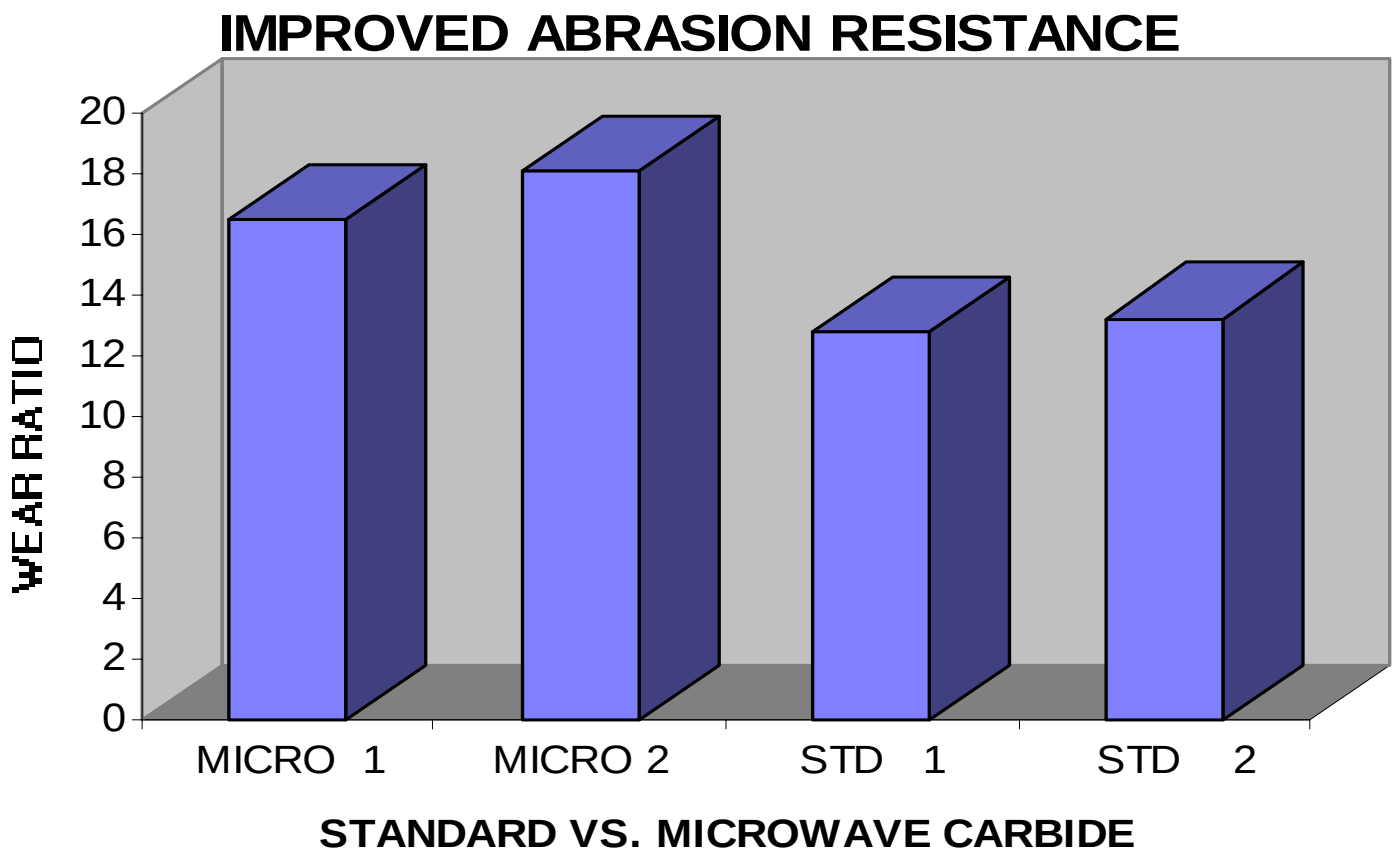
# MICROWAVE SINTERING OF WC-Co BASED CEMENTED CARBIDES

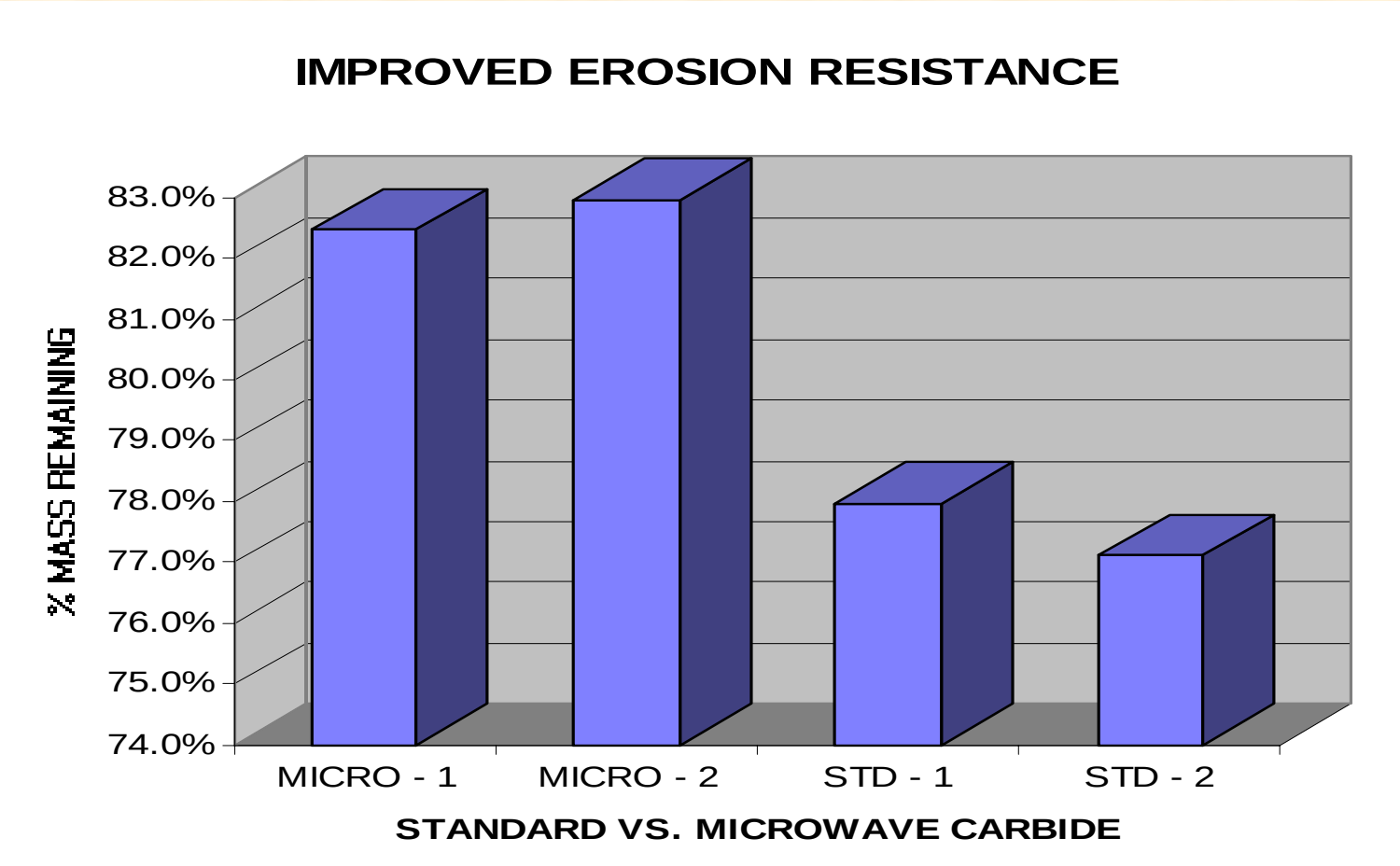
# Rockwell A Hardness

| Co wt.% | Heating Process | Sintering °C/time | ardness |
|---|---|---|---|
| 6 | MW | 1450/10min. | 88.25± 0.67 A |
| 6 | Conv. | 1450/1hr | 81.80± 0.91 |
| 12 | MW | 1300°C/10 min | 88.87± 0.10 |
| 12 | Conv. | 1300°C1h | 84.84± 0.53 |
| 12 | MW | 1350°C/10 min | 87.16± 0.21 |
| 12 | Conv. | ~1440°C/~2h | 86.32± 0.41 |

# ABRASION RESISTANCE



# EROSION RESISTANCE

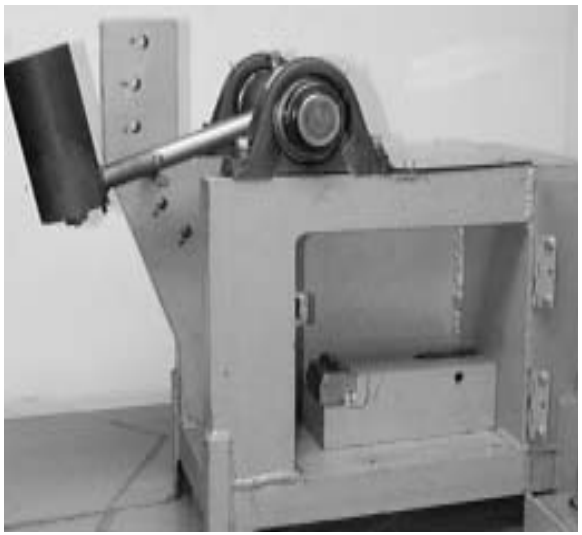


# IMPROVED EROSION RESISTANCE

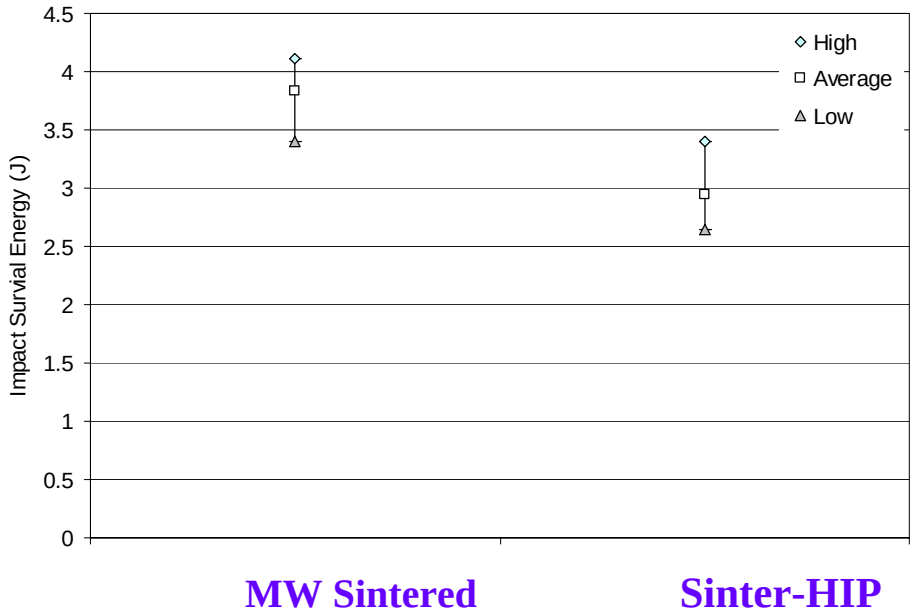
MICROWAVE SINTERED

CONVENTIONALLY SINTERED

# Improved Impact Strength



Impact Apparatus



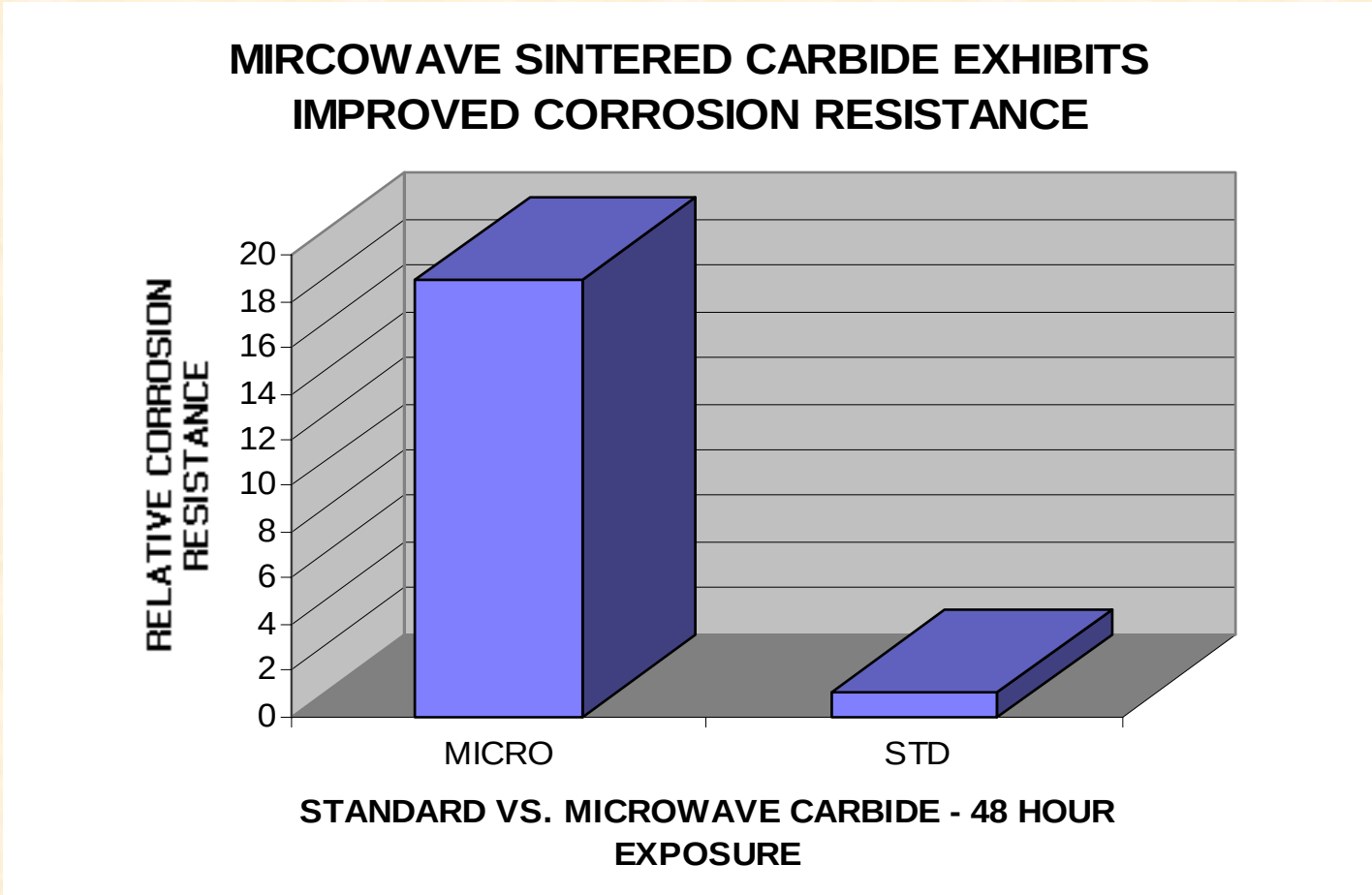
# COMPARISON OF CONVENTIONALLY AND MICROWAVE SINTERED WC-Co DRILL PARTS

## IMPROVED IMPACT STRENGTH

MICROWAVE SINTERED

CONVENTIONALLY SINTERED

# IMPROVED CORROSION RESISTANCE



# ROLLING CONE BIT COMPONENTS
# PDC, CARBIDE, MICROWAVE SINTERED TSD

# MICROWAVE SINTERED TSD COMPOSITE INSERTS

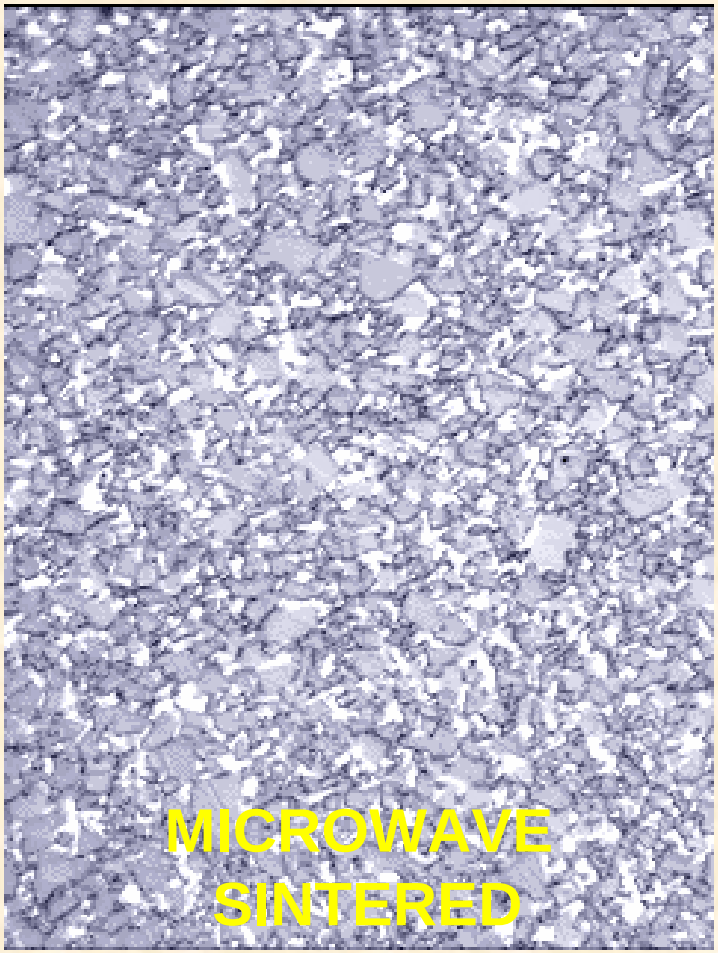
**ABRASION RESISTANT TSD MICROWAVE SINTERED IN TUNGSTEN CARBIDE**

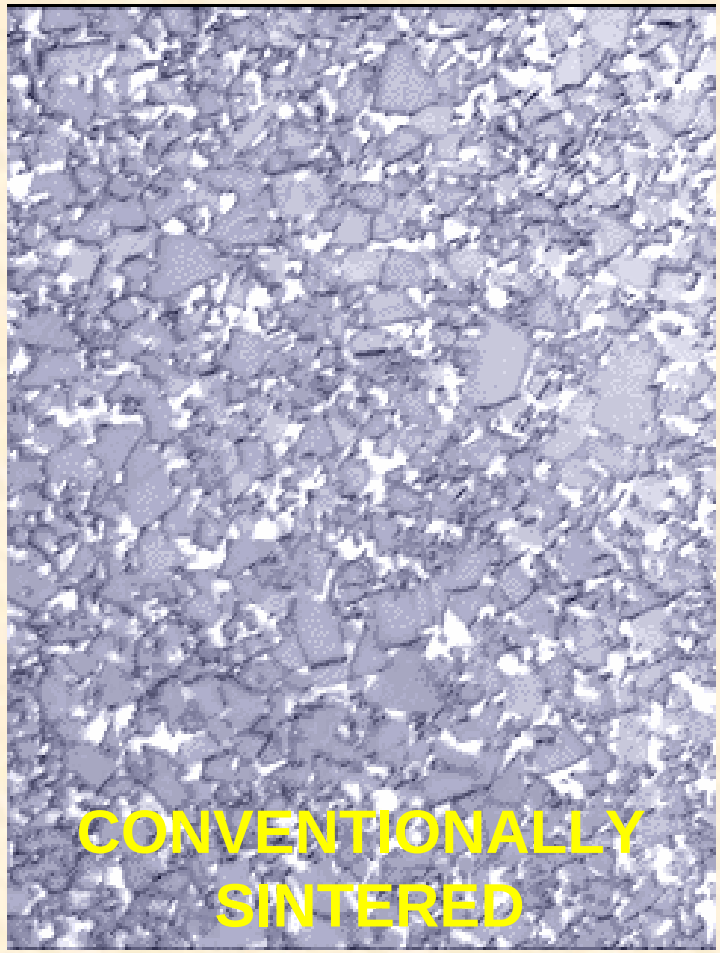
**Part 12154**
**14.4mm DIAM x .12.7mm LONG**
**3 TSD ELEMENTS 4mm DIAM.**

# MICROWAVE SINTERED TUNGSTEN CARBIDE IMPROVED PROPERTIES

- Fine grain structure
- No grain growth inhibitors
- Uniform cobalt distribution
- Improved abrasion resistance
- Improved erosion resistance
- Improved corrosion resistance
- Improved impact strength
- More energy efficient process
- Less capital intensive

# FROM IDENTICAL GREEN PARTS at 1500X



# V1.5 Microwave Sintering Furnace

DENNIS TOOL COMPANY

Dimensions and Weight
36"x 145"x 114"
3500 lbs

Microwave Power & Frequency
6.0 kW at 2.45 GHz

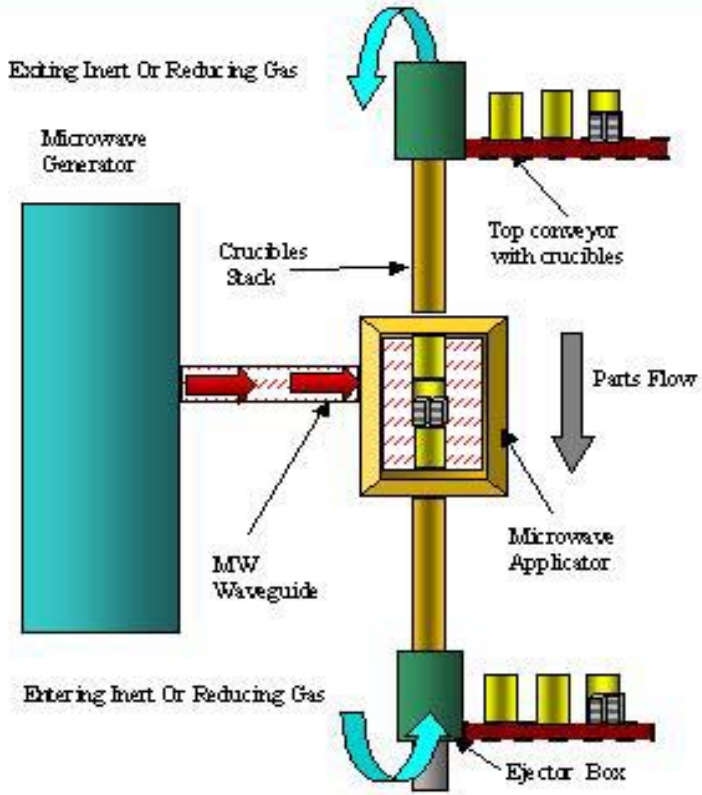
Cooling Requirements
Water at 70° +/- 10° F at 50 psig
MW Generator 1.5 gpm
MW Applicator 1.5 gpm

Electrical Requirements
MW Generator
120 vac/3 phase at 50/60 Hz circuit 20 A
Hydraulic drive
230/460 vac/3 phase at 60 Hz circuit 15 A
Applicator
120 vac/1phase at 60 Hz circuit 30 A

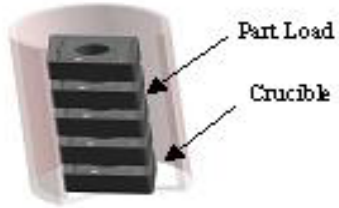
Maximum operating temperature
1500° C (2732° F)

Atmosphere Multi-mode
Inert or Reducing gas

Crucible Size – Volume 1.50 cu. inch
1.10" OD / 0.98"ID
2" Height



# V1.5 Microwave Furnace Capacity Chart




| Part Description | Part Sintered Dimensions | Parts per Layer | No. of Layers | Parts per crucible | Parts per 24 hr.[1] | Carbide Parts |
|---|---|---|---|---|---|---|
| **Cutting Tool Inserts** | | | | | | |
| CNMG 322 | 0.375" x 0.125" | 1 | 6 | 6 | 1555 | |
| CNMG 434 | 0.500" x 0.187" | 1 | 5 | 5 | 1296 | |
| DCMG 442 | 0.500" x 0.250" | 1 | 1 | 1 | 288 | |
| DCMG 542 | 0.625" x 0.250" | 1 | 1 | 1 | 288 | |
| SNMG 322 | 0.375" x 0.125" | 1 | 6 | 6 | 1555 | |
| SNMG 432 | 0.375" x 0.187" | 1 | 5 | 5 | 1296 | |
| TNMG 221 | 0.250" x 0.125" | 2 | 6 | 12 | 3110 | |
| TNMG 321 | 0.375" x 0.125" | 1 | 4 | 4 | 1036 | |
| **Rolling Cone Drill Bit Inserts** | | | | | | |
| Gage cylinders | 0.375" x 0.250" | 2 | 4 | 8 | 2073 | |
| Gage cylinders | 0.500" x 0.375" | 1 | 3 | 3 | 777 | |
| Cutting domes | 0.375" x 0.250" | 2 | 4 | 8 | 2073 | |
| rounds, chisels | 0.500" x 0.375" | 1 | 3 | 3 | 777 | |
| **PDC Substrates** | | | | | | |
| 13 mm rounds | 0.540" x 0.315" | 1 | 3 | 3 | 777 | |
| 19 mm rounds | 0.780" x 0.315" | 1 | 3 | 3 | 777 | |
| **Wire Die Nibs** | | | | | | |
| R-4 Nib | 0.500" x 0.450" | 1 | 2 | 2 | 518 | |
| R-8 Nib | 1.000" x 0.820" | 0 | 1 | 0 | 0 | |
| **Mining Bits Inserts** | | | | | | |
| 1" Roof-bolt | 1.025" x 0.185" x 0.525" | 2 | 1 | 2 | 518 | |
| 1-3/8" Roof-bolt | 1.400" x 0.185" x 0.675" | 1 | 1 | 1 | 259 | |
| 1-1/2" Roof-bolt | 1.525" x 0.185" x 0.775" | 0 | 1 | 0 | 0 | |

[1] The furnace capacity chart is intended as guide line. Crucible capacity is based upon a nominal 20% dimensional shrinkage. Furnace throughput is based upon a 5 minute sintering cycle for a 24-hour period at 90% efficiency. Actual part per crucible loading and furnace throughput may vary from the stated values above.